STRATIGRAPHIC ANOMALIES IN THE MARTIAN NORTH POLAR LAYERED DEPOSITS. A. V. Pathare[1,2], J. A. Arnold[2], and B. C. Murray[2]. [1]Planetary Science Institute (1700 E. Ft Lowell, Suite 106, Tucson AZ 85719; pathare@psi.edu), [2]California Institute of Technology.

Introduction: We have identified numerous examples of anomalous trough stratigraphy within the North Polar Layered Deposits (NPLD). According to the standard model of NPLD stratigraphy [1], troughs can be divided into three main units: (1) Layered Terrain, which exhibit fine-scale laminae upon equatorward-facing (EWF) trough slopes; (2) Banded Terrain, more diffuse layers located on poleward-facing (PWF) trough walls; and (3) Smooth Terrain, which span the featureless regions between the troughs.

PWF Layered Terrain: However, our preliminary survey of NPLD trough stratigraphy (Fig. 1) has revealed numerous exposures of Layered Terrain on PWF trough slopes. For example, the HiRISE image in Fig. 2 clearly shows layers that continuously wrap around a bowl-shaped depression located upon an NPLD trough wall. Our topographic analysis of this trough—which involves using lower-resolution MOC (Mars Orbiter Camera) and THEMIS (Thermal Emission Imaging System) images to place the HiRISE footprint upon MOLA (Mars Orbiter Laser Altimeter) topography—confirms that fine-scale layers are expressed on PWF slopes (Fig. 2). Such PWF Layered Terrain has important implications for the local mass balance of the trough, since deposition of a millimeter-thick layer is more than sufficient to alter surface albedo and obscure the trough wall [2]. Hence, the presence of PWF layered terrain effectively precludes significant accumulation of water ice within a trough.

As shown in Fig. 1, we have identified as many as twenty exposures of PWF Layered Terrain throughout the NPLD using HiRISE and MOC images, which strongly suggests that water ice deposition is not presently occurring within most NPLD troughs. In order to assess the frequency of these anomalous features, we decided to systematically inspect the 20 largest troughs in the NPLD (Fig. 1). We classified the troughs based on the number of internal ridges: "simple" troughs (outlined in yellow) have no such ridge, while "complex" troughs have either one (orange) or two (red) interior ridges. As seen in Fig. 1, almost all of the simple troughs do not exhibit PWF Layered Terrain, in accordance with the standard model. However, the majority of complex troughs (7 out of 11) contain at least one exposure of PWF Layered Terrain (as indicated by the green circles in Fig. 1).

EWF Banded Terrain: Even more surprisingly, several complex troughs also exhibit EWF Banded Terrain (green triangles), which is also discordant with

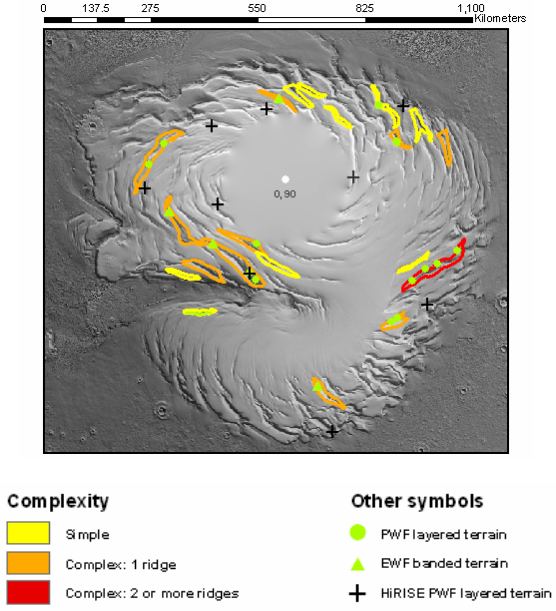

Figure 1: Anomalous Trough Stratigraphy. Exposures of PWF Layered Terrain and EWF Banded Terrain. Outlines correspond to twenty largest NPLD troughs (as defined by surfaces with contiguous poleward-facing slopes steeper than 1.5º), which are subdivided based on the number of internal ridges.

the standard model of trough stratigraphy. An example of such EWF Banded Terrain is shown in Fig. 3: note that the EWF slope in the center of the unlayered Banded Terrain along the interior ridge is actually *higher* than an EWF slope along the main trough wall that is clearly layered. This demonstrates that the manifestation of this unusual trough stratigraphy is not simply a function of insolation.

Whereas the presence of PWF Banded Terrain argues against recent net deposition in the NPLD, the existence of EWF Banded Terrain suggests a corresponding lack of recent net sublimation (otherwise, the Layered Terrain that presumably underlies the Banded Terrain would be revealed). Consequently, we conclude that the NPLD mass balance history has been relatively quiescent since the deformational event that produced internal ridges within complex troughs, since the associated stratigraphic anomalies (Fig. 1) appear to preserve the slope-dependent mass balance pattern that prevailed *prior* to the formation of these ridges.

References: [1] Howard A. D. et al. (1982) *Icarus, 50,* 161–215. [2] Bass D. S. et al. (2000) *Icarus, 144,* 382-396.

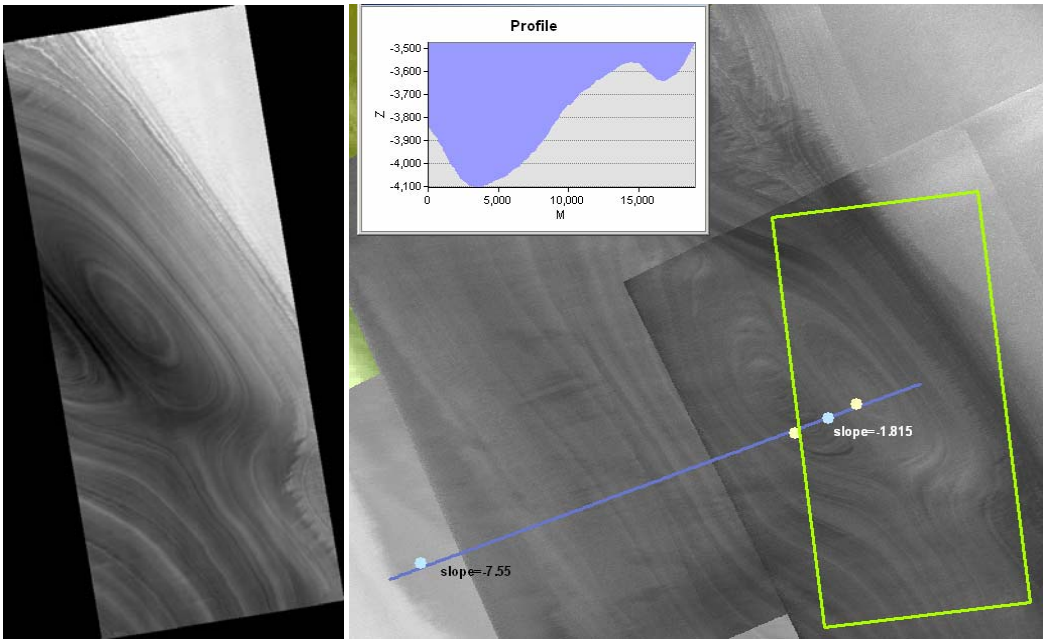

Figure 2: PWF Layered Terrain. (left) HiRISE image PSP_001730_2660OC, centered at 85.7°N and 339.1°E, taken at L_s 147.6°. (right) MOC and THEMIS images of same NPLD trough (green box corresponds to HiRISE footprint). Inset shows MOLA profile along blue line. White dots represent top and bottom of PWF slopes within the depression. North is to the upper right.

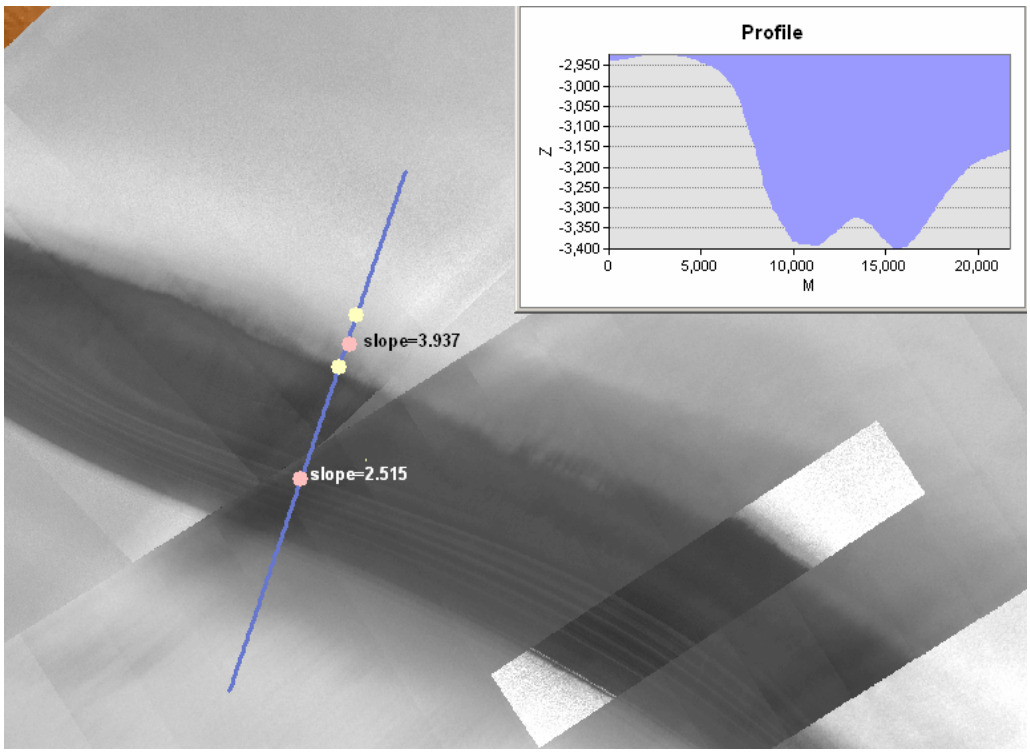

Figure 3: EWF Banded Terrain. THEMIS and MOC images of north polar trough located at 86.4ºN and 174.7ºW. Inset shows MOLA profile along blue line. White dots represent top and bottom of EWF slopes along the central ridge. North is towards the bottom of the image.